

Forthcoming in *Journal of Management Development*

(DOI: 10.1108/JMD-08-2017-0263)

## **Reviewing Cognitive Distortions in Managerial Decision Making. Towards an Integrative Co-Evolutionary Framework**

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### **Abstract**

**Purpose** – Why and how do cognitive distortions in managerial decision making occur? All organizations are *imperfect systems* (Katz and Khan, 1966), with wrong decisions often just round the corner. As a consequence, addressing these important questions continues to be particularly lively in the management development area, especially in terms of its intended contribution to the de-biasing activity. Thus, through this critical review article we aim to provide the current scientific dialogue on the topic with updated lenses, which can also be innovative from some aspects.

**Design/methodology/approach** – Our review framework is based on the recent, impactful article on biases in managerial decision making by Kahneman *et al.* (2011), and on Bazerman and Moore's (2013) perspective on emanating heuristics, considered as the causes of biases. Accordingly, we derive four intertwined thematic clusters of heuristics, through which we systematically group and critically analyze the management literature mostly published on the topic since 2011.

**Findings** – From the analyzed clusters we propose an integrative framework of emanating heuristics, which focuses on the co-evolving relationships and potentially self-reinforcing processes in and between them.

**Originality/value** – The value of our contribution is threefold: 1) from a methodological perspective, to our knowledge, the studies adopted as the basis of our analysis have not yet been simultaneously used as a comprehensive ground for updated reviews on this topic; 2) from a conceptual perspective, the emerging integrative co-evolutionary framework can help explain the dangerous connections among cognitive traps and emanating heuristics; 3) from a practical perspective, our resulting framework can also be helpful for future de-biasing attempts in the business arena.

**Keywords:** Cognition; Decision Making; Heuristics; Literature; Management Development; Co-evolution.

# **Reviewing Cognitive Distortions in Managerial Decision Making. Towards an Integrative Co-Evolutionary Framework**

## **1. Introduction**

Why and how do cognitive distortions in managerial decision making occur? Addressing these important questions continues to merit pivotal attention in both the literature on and practice of management development, particularly for its potential contribution to de-biasing techniques, which are constantly growing thanks to the continuous scientific dialogue between business experts and psychologists globally.

The reason why the questions above remain lively to date is classical, apparently simple, yet still meaningful: all organizations are managed by human beings, and wrong decisions, by individuals or groups, are often just round the corner (Katz and Kahn, 1966). Some experts maintain that companies may drastically improve their performance by shifting to *diligence*-based decision making (Powell, 2017). Rather than focusing on the expansion of analytics, decision makers should use existing datasets and avoid several cognitive distortions (Sibony *et al.*, 2017).

Over time, scholars have extensively questioned the assumption that individuals function as rational decision makers. The *bounded rationality* concept (Simon, 1947) seminally proposes the most prominent explanation for the fallacy of the fully rational model of decision making, based on three main factors limiting our rationality. First, individuals cannot have complete information needed for discounting the consequences following each decision. Second, individuals can only imperfectly anticipate the future occurrence of these consequences, because their imagination substitutes experiential knowledge for attributed values. Third, individuals lack knowledge about all the possible decisional alternatives in any given moment, which is necessary to make rational decisions. In sum, because the cognitive

information processing capacity is physiologically limited, cognitive distortions are far from being remote scenarios.

Understanding why and how cognitive distortions often affect managerial decision making still remains unaddressed from many angles; thus, we have developed this critical review to provide the current scientific dialogue on the topic with updated lenses, which can also be innovative from some aspects. In this regard, the remainder of our article is as follows: by drawing on the research design of recent reviews published in the *Journal of Management Development* (Yahaya and Ebrahim, 2016), we first explain the motivation behind our work and the choice of our research framework; in this case, the framework is based on the recent article on biases in managerial decision making published by Kahneman *et al.* (2011), and on Bazerman and Moore's (2013) perspective on emanating heuristics, considered as the causes of biases. Although these studies have been breakthroughs and impactful both for scholars and practitioners in the field, to our knowledge they have not yet been simultaneously used as a comprehensive basis for an updated review on this topic. In particular, thanks to the contemporaneous use of these studies, we derive four intertwined thematic clusters of emanating heuristics, through which we systematically group and critically analyze the management literature mostly published on the topic since 2011. Discussions and implications for management development follow.

The main value of our article, we believe, is that from the analyzed clusters we propose an integrative framework of co-evolving and potentially self-reinforcing emanating heuristics – a framework from which, we also believe, the future de-biasing activity in the practice of business could benefit. In fact, on the one hand, the framework can help recognize the inner cognitive distortions at the basis of the (more explicit) emanating heuristics; on the other hand, it can help study cognitive distortions more holistically, through exploiting the most vivid linking pins between the biases and heuristics themselves.

## 2. Motivation and framework of the review

The Merriam-Webster dictionary defines the term heuristics as “involving or serving as an aid to learning, discovery, or problem-solving by experimental and especially trial-and-error methods”. The term derives from the Greek *heuretikos*, which means “serving to discover or find out”. Newell and Simon (1972) seminally conceive heuristics as those cognitive shortcuts which our brain tends to use when its decision making process is limited, in terms of time and data availability. Thus, heuristics are self-learning strategies used to solve problems by searching and evaluating alternatives which we cannot handle through logic and probability theory. In fact, exhaustive searching is often impractical and we use heuristic methods to speed up the process of finding satisfactory solutions. In sum, we tend to make what is commonly referred to as an educated guess.

Stemming from bounded rationality, subsequent studies attempt to answer Simon’s main theoretical question of how humans reason when the conditions for rationality supposed by neoclassical economics are not met (Cristofaro, 2017a). This question leads to two main schools of thought: Tversky and Kahneman’s *heuristics-and-biases* programme (1974), and Gigerenzer and Selten’s *adaptive toolbox* (2002). In 2003, Kahneman writes that he and Tversky have explored “a territory Simon had defined and named — the psychology of bounded rationality” (p. 697). In contrast, Gigerenzer and Selten claim that, for bounded rationality, Simon does not mean irrationality as, according to them, in Tversky and Kahneman’s *heuristics-and-biases* programme, but, instead, models that adopt a fast-and-frugal rule for search.

Uncertainty is a defining characteristic of human decision making. In real situations, human decision making has to fit with the individual’s bounded rationality and the environmental setting. Thus, the decision maker does not know all the possible options, with their consequences and probabilities. In Hilbert’s words, “our mind is the result of biological

evolution, which does not strive for perfection or even theoretical optimization, but simply for a competitive degree of fitness in a specific environment” (2012).

The main question then becomes to understand when heuristics are useful and when they are harmful. In particular, we need to understand how to make heuristics more accurate, how to choose the most suitable heuristic, given our environment, and how to use them and cope with errors potentially arising. For example, the *bounded awareness* heuristic affects the information selection process; to avoid information overload, people often filter information unconsciously and automatically. This could lead to ignoring or neglecting useful, observable, and relevant data. Bounded awareness mainly derives from our tendency to over-focus. Focusing limits our awareness, with important information outside the range of our focus potentially disregarded. This is why texting and driving at the same time is highly dangerous; by focusing on the mobile phone, we overlook the presence of other cars.

In sum, heuristics can often lead to systematic biases (Hammond *et al.*, 1998). Biased judgment and decision making is the human tendency to make systematic errors based on cognitive factors rather than evidence. When choosing between alternatives, people make predictably irrational choices, often resulting in the same types of deviation that rational models predict. According to Bazerman and Moore (2013), common biases can be associated with and categorized within their *emanating* heuristic.

Why are biases so important? As Kahneman (2011) explains, the irrational manner in which the human brain often works influences people’s decisions in ways that they and others around them fail to anticipate. The errors resulting from a biased process prevent us from making sound decisions. Moreover, even when we have gathered abundant work experience and knowledge, we are still subject to those biases and, in certain cases, even more subjected than inexperienced people.

Over time, management scholars have attempted to support the recurring belief that while heuristics may influence business decisions either *in peius* or *in melius* (e.g., Azas, 2014; Artinger *et al.*, 2015), cognitive biases always have a negative effect on business choices (e.g., Abatecola and Uli, 2016; Cristofaro, 2017b; Mazutis and Eckardt, 2017). To reduce biases, both scholars and practitioners have tried to develop techniques and methods, which, to date, cover an ample *spectrum* of fields and whose nature and purpose are heterogeneous (Cristofaro, 2017c). For example, based on qualitative and quantitative approaches, these techniques have recently included *management styles* (Adizes, 2004), *pre-mortem* (Klein, 2007), *considering the opposite* (Graf *et al.*, 2012), *third-party direct intervention* (Caputo, 2016), *cognitive diversity* (Meissner and Wulf, 2017) and *Mindspace* (Liu *et al.*, 2017).

On this premise, the most promising de-biasing technique currently seems to be the cross-disciplinary checklist recently published by Kahneman *et al.* (2011) in their *Big Idea* article. According to this technique, a third person is needed in order to recognize and moderate the potential effects of distortions in the business decision making processes, through questioning decision makers with a set of 12 questions (each one linked to a precise trap, that can cover self-thinking processes, recommenders' thinking processes, or features of the proposal under assessment). These links simplify the role of the third party, who has the duty of identifying the distortions and attempting to minimize their effects. This method has its theoretical pillars in the existence of System 1 and System 2 in our mind. In this regard, according to Kahneman (2003), the human cognitive functioning occurs in two different "Systems" of the human brain. System 1 is where the intuitive and unconscious thinking lies, while System 2 is where the thought is far more reflective and where individuals recognize the mistakes that occurred during reasoning. The operations of System 1 are fast and automatic, usually also emotionally driven; thus, they are difficult to control or modify. Conversely, the cognitive operations of System 2 are "more likely to be consciously monitored and deliberately controlled"

(Kahneman, 2003, p. 698). Kahneman (2003) also underlines that the output of System 1 is unmonitored by System 2. On this basis, the presence of a third party is pivotal for controlling the quality of decisions, because this allows the third party to identify the distortions occurring in the decision maker's System 1.

We have, therefore, decided to use Kahneman *et al.*'s (2011) recent framework as the comprehensive basis for our review for two main reasons: 1) from the beginning, this framework has not only been widely considered as innovative in the managerial decision making field, but also reliable and prospectively impactful, especially in its strong cross-disciplinary implications for management development; 2) to our knowledge, the framework has not been used as a specific way for systematically grouping and subsequently analyzing the most recent literature on the topic (see Table 1).

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As Table 1 reports, column 1 shows the 12 questions contained in the checklist created by Kahneman *et al.* (2011); in this regard, we have replicated the same initial classification because not only does it focus on content when executives review and challenge recommendations, but it pushes towards the sequential review of the recommendation process itself, in order to “retrace (executives’) steps to determine where intuitive thinking may have steered them off-track” (Kahneman *et al.*, 2011, p. 53). Accordingly, columns 2 and 3 draw on Bazerman and Moore’s (2013) classification, and subsequent developments (e.g., Caputo, 2013), to show the cognitive traps and “emanating” heuristics associated with the questions. In fact, according to Bazerman and Moore (2013, p. 37), cognitive traps are the effect of, or can be easily reconnected to, few heuristic mental mechanisms; the latter, in practice, influence our recollections and predictions, which, in turn, negatively and unconsciously

affect our own mental processes (i.e., leading to cognitive traps). In this regard, column 3 assumes a key role in our review. Consistently with the research design of recent review articles (e.g., Yahaya and Ebrahim, 2016), we have used the framework provided by the emanating heuristics to categorize articles around four thematic clusters: affect, availability/representativeness, confirmation, risk aversion. We have then reviewed the most representative studies (Table 1/column 4) published on the topic, with a particular focus on articles published after Kahneman and colleagues' article in 2011.

### **3. Affect**

Judgments are usually evoked by an affective evaluation happening even before any higher-level reasoning occurs. This conceptualization is seminally studied by Zajonc (1980), who provides evidence that individuals' affective states may: *i)* separately (from cognition) act on the information processing mechanism, *ii)* influence and be influenced by cognition, and *iii)* be the first response when the situation calls for rapidity in making decisions. Stemming from this last point, Finucane *et al.* (2000) interpret this mechanism as a heuristic; in practice, emotions substitute logical reasoning when decision makers have to rapidly assess the risks and benefits of a choice situation to improve the judgmental efficiency. The importance of this heuristic is subsequently highlighted by Dreman (2004), who retrospectively interprets the "dotcom bubble" in the early 2000s as being the outcome of investors' affect heuristic. Indeed, according to him, the low level of scrutiny of highly risky stocks in bubbles is determined by the emotional link of investors with new start-ups' dreams, which, however, have offered much lower returns than S&P 500 companies in the last two decades (81% vs. 751% respectively).

Due to this recognized importance, in recent years scholars have explored the affect mechanism under the lens of the different affective states that can influence managerial



decisions. For example, investigating the decision making of film directors, Coget *et al.* (2011) find that moderate intensity fear allows rational decision-making, while high intensity spreads more intuitive decision making. It therefore seems that affective states are connected with the search strategy of individuals, particularly with their tendency to collect confirming or divergent information. For example, Elsbach and Barr (1999) find that individuals experiencing a moderately negative mood are significantly more likely than those in a moderate positive mood to accurately follow all the steps of a structured decision protocol in its correct order. In other words, people with moderate-high levels of positive affect are more inclined to deviate from the beaten path and, as a consequence, to collect non-related information. Welpel *et al.* (2012) find that the exploitation of strategic decisions is reduced if decision makers experience fear, while the amount of strategic alternatives increases if they are in a joyful or angry mood. In contrast, Bachkirov (2015) finds that happiness and anger cause the decision maker to process less decision-relevant information.

All this stated, Pachur and Galesic (2013) show that not only can the overload of information lead to choosing alternatives to which there is an affective link, but also that poor logic ability and cross-cultural differences play a pivotal role. Indeed, they find that the affect heuristic is usually implemented by less numerate decision makers (American people in their study), while more numerate decision makers (Germans) usually follow a minimax strategy. This result is later confirmed by Sokolowska and Sledoba (2015), who find that, during important strategic choices, decision makers who are experts in the object of the investment can avoid superficial evaluations because of their knowledge; however, in investment evaluations that evoke strong feelings, because of the decision makers' involvement or social controversies regarding the object of assessment, risks and benefits are negatively correlated.

However, despite these different developments, risk aversion still remains the most investigated driver of the affect heuristic; indeed, Schlösser *et al.* (2013) clearly demonstrate

that both anticipated and immediate emotions of the decision makers drive risky decisions. In particular, decision makers are concurrently influenced either by the emotions elicited by the subjective assessment of the perceived risky decision, or by the affective states emerging while contemplating the various options; however, the latter have a more significant effect in selecting alternatives. In practice, executives make decisions according to how they feel about the “riskless” portion of the decision, rather than according to their forecasted outcomes. Nonetheless, this relationship is twofold; as previously hypothesized and proved, affective states can, differently, amplify or reduce the perception of risk according to their prevalence and magnitude.

Moreover, according to the experimental results of Townsend *et al.* (2014), the affect heuristic seems to interact in a deliberative way – rather than implicitly – with the perception of risk. Decision makers, in practice, explicitly assess the risk of decisions according to their cognitive resources and capacity (when they have them), otherwise they implicitly assess risk according to their affective states. However, the degree of perceived risk differently drives the use of deliberative or implicit assessment; the explicit use of affect is activated when the perceived risk is high, while the implicit mechanism works when this risk is low.

#### **4. Availability and representativeness**

The *availability heuristic* exists when people assess the probability of a future event on the basis of what past occurrences of that event are readily available in memory, which is not always correct (Tversky and Kahneman, 1973). Availability also applies to recent events. Indeed, this time effect appears because we tend to recall recent events more easily and therefore assume that they are more likely to happen. Relatedly, the *representativeness heuristic* exists when, in making a judgment about an individual, object, or event, people tend to look for traits corresponding to previously formed stereotypes (Kahneman and Tversky,

1974). Thus, we judge a few elements and automatically classify them into that category and, although this heuristic can be helpful in saving energy and time, stereotypes are just round the corner.

On this premise, Mitchell and Shepherd's (2011) study of the psychological underpinnings behind erratic strategic decisions finds important supportive results to the understanding of executives' cognitive functions in strategic decision making. In particular, through the investigation of 2,048 decisions made by 64 CEOs of medium sized technology firms, these scholars look at the interplay between the metacognitive experience of executives (i.e., a person's conscious experiences that are cognitive and affective in nature) and the dynamism/hostility of the environment. In the strategic choices analyzed, regarding executives' willingness to invest in an opportunity, executives with great metacognitive experience make fewer erratic strategic decisions, but these results change according to their perception of the environment; in fact, executives perform more erratic decision making when they perceive the environment as hostile rather than dynamic – i.e., when they are able to associate the ongoing situation with one they are familiar with.

However, in an environment that lacks fixed patterns, such as financial markets, where, every day, a small new piece of microeconomic or macroeconomic news can bring high upturn or downturn, decision makers' cognition is affected both by their limited information and time pressure to make a decision about whether or not to abandon their positions (Bachkirov, 2015). In this case, following the available actions of the most renowned investors – represented as “winners” in decision makers' minds – is the most applied heuristic in order not to look over their own shoulders. In this regard, Pentland (2013) explains how this intertwined heuristic improves traders' social learning and financial performance. In particular, he shows that, among the different behavioural patterns, traders choosing to copy the available strategy of people regarded as successful, reach greater rewards.

Bingham and Eisenhardt (2011) also provide proof that managers develop and use the availability and representativeness heuristics in strategic situations. In particular, they contend that firms learn and apply these heuristics in strategic contexts when time is short, information is limited, and the situation is novel. For example, one of their analyzed firms – U-Analytics – does not lose time in replying positively to the invitation of a third party to enter Australia, even though it knows little about this country. This results from the application of the representativeness heuristic, explicated as “restricting internationalization to English-speaking markets”, driven by the simplicity in entering contexts featuring a similar culture. Although in different contexts, Jones (2015) and Mugerman *et al.* (2016) similarly find that availability and representativeness interact, with the former affecting the latter. For example, Mugerman *et al.* (2016) discover that decision makers facing long-term investments are influenced first by the short-term interest rate changes available, that later can be representative of fixed or adjustable rate decisions.

The heuristic view barely reported is obviously positive through attributing, according to these rules of thumb, the possibility to simplify human judgment under certain conditions; however, as written, heuristics can also present negative effects on decision making. In this regard, for example, Graffin *et al.* (2013) investigate what factors influence the evaluation of CEOs in the early stage of their appointment, through observing 432 CEO successions in Fortune 1000 firms. Evaluating new CEOs in their early stages is difficult, because, for example, of the influence of their past actions. Thus, this research shows that, in their evaluation process, boards use the representativeness heuristic in appointing new CEOs. In particular, Graffin *et al.* (2013) find that CEO candidates having experience in that position lead the governance to apply representativeness, through which potential directors are perceived as more successful than others that do not have this background; being seen as similar to the current CEO, in practice, gives more chances – at least 60% more – of not being

replaced in the first years of tenure.

Finally, besides the interplay between availability and representativeness, there exists another pivotal interaction between the former and the affect heuristic. Indeed, as recently discovered by a series of experiments by Pachur *et al.* (2012), availability and affect can be comprised of a unique mechanism that combines both, either sequentially or in a composite manner. In particular, evidence shows that the accuracy of the decision maker's perception of risk is driven by the calibration of the measure used, which may be simultaneously formed by the available direct experiences or by the affective dimensions of risk. These results also confirm the previous findings by Wählberg and Sjöberg (2000), who demonstrate the distortional effect of the information made available by media on risk perception, as well as the indirect influence of the available information on risk perception via affective states.

## **5. Confirmation**

The *confirmation heuristic* appears when people use selective data for testing hypotheses, such as instances in which the variable of interest is present; decision makers, in practice, tend to selectively search for supportive information, discarding the opposite. The most relevant consequence of the confirmation heuristic is *overconfidence*, defined by Bazerman and Moore (2013) as the “mother of all biases”, because it has some of the most pervasive effects and facilitates many other biases. Overconfidence is the situation in which individuals tend to be overconfident about the infallibility of their judgments and it has been found in many settings.

Confirmation and overconfidence are closely connected; in fact, people that become too sure about their own answers tend to overlook relevant information, alternatives and new evidence. For example, Shiller (2005) demonstrates that the stock markets were overvalued both in the case of the dot-com and real estate bubbles. These bubbles were led by the general enthusiasm towards these growing markets, mainly due to the overconfidence of decision

makers in obtaining high returns, which increasingly pushed to retrieve and collect only confirming information.

The mechanism above also seems to work when looking at the behaviour of entrepreneurs and MBA students when asked if they would compete in low or high competitive environments (Cain *et al.*, 2015). Indeed, results show that both the groups tend to enter those competitions featuring easy tasks, because they believe themselves to be better than the others. These results are meaningful, especially if taking into account that the study's participants expect that their supposed competitors make the same choice (i.e., entering the easy market); thus, even if they are aware that making the decision to enter an easy market would put them into a strong competition, they do not consider entering a more difficult market because they overestimate their scores. This result confirms the prior work by Gudmundsson and Lechner (2013), who find that overconfidence is the most detrimental bias for firms' survival in the first years of their life cycles.

Relatedly, Chen *et al.* (2015) investigate how overconfidence may occur when CEOs make corporate earnings forecasts. Testing the difference between at least two corporate earnings forecasts made by 217 CEOs in a 14-year time span (1994-2008), Chen and colleagues find substantial supportive results to their hypothesis that CEOs with greater overconfidence are resistant to strong corrective feedback. However, as Park *et al.* (2011) explain, CEO overconfidence may be pivotally determined by high levels of *ingratiation*, in terms of flattery and opinion conformity from other executives. In particular, these scholars investigate this phenomenon through surveys about opinion conformity from 451 CEOs of US firms and 3,135 other executives identified as potential *ingratiators*. Their results totally support the initial hypotheses that CEOs with high social status are positively associated with CEO overconfidence and opinion conformity from other executives; this interplay brings to a low perception the need to change strategy in response to poor performance.

Strictly associated with overconfidence is also *unrealistic optimism bias*, defined as the tendency to overestimate the rosiness of our future, and also deriving from the confirmation heuristic. This bias has been observed in several domains and for the majority of people. Indeed, according to Sharot, “studies consistently report that a large majority of the population (about 80% according to most estimates) display an optimism bias” (2011, p. R942). Moreover, this bias seems to work not only before the decision making, but also in post-decisional moments. In fact, Meyer (2014) finds that decision makers involved in evaluating the business benefits to be delivered by their projects, usually forecast that related results will be higher than those previously planned; this brings to team members an escalation of commitment to failing projects. Similarly, from a survey administered to more than 800 CEOs, Langabeer and DelliFraine (2011) find that optimistic directors usually tend to use an incremental strategic process based on heuristics (such as availability and representativeness), as opposed to a comprehensive, rational process based on analysis. In practice, executives with high levels of optimism tend to rely on heuristics rather than rational processes for strategic decision making. Yet, Pandher and Currie (2013) find that optimism is usually connected with the risk aversion phenomenon; indeed, from their study, CEOs who underestimate risks emerging from competitiveness and are too confident about firm performance will experience higher compensation in equity rather than in variable cash pay.

Finally, *anchoring* can be another possible negative driver of the confirmation heuristic. On this side, through the examination of focal premiums in 13,442 deals from 1986-2011, Malhotra *et al.* (2015) show that managers, consciously or unconsciously, rely on previous acquisition premiums paid in similar and time-close operations in their market, thus referring to the availability and representativeness heuristics. In this case, it seems that managers voluntarily search for a precedent and similar M&A operations to rely on for concluding their own operation, with the implicit drawback of not looking at the potential of the specific

operation. However, also for this trap there exists a direct link with the risk aversion heuristic, as demonstrated by Workman (2012). In particular, stemming from the fact that the outcome of the anchoring mechanism is usually the overestimation of probabilities (Tversky and Kahneman, 1981), leading to the overconfidence bias, Workman's quasi-experimental study demonstrates that executives who generally have low risk aversion tend to both anchor their decisions on prior confirmatory data and continue a strategic initiative; moreover, results highlight that this process is amplified if these initiatives are positively framed.

## **6. Risk aversion**

Prospect Theory (Kahneman and Tversky, 1979), disruptively challenges the expected utility axioms of decisions under risk, affirming that people who must make a decision among risky options primarily assess the potential value of the alternatives' losses and gains, rather than the final outcome, through the use of heuristics. One of these shortcuts is risk aversion. According to Kahneman and Tversky, risk averse people tend to search for options with moderate probabilities of gains and small probabilities of losses; while, risk-seeking decision makers look for options featuring moderate chances of losses or small chances of gains. Moreover, decision makers' preferences are driven by the formulation of the decision problem. In particular, people choose different options (generating inconsistencies) according to the positive or negative way in which the problem is posed, mainly because the different framing produces different perceptions of risks that, as a consequence, influence the decision makers' affective states and their search strategies.

Because of the relevance of these effects, over time scholars have looked at the risk aversion and associated *framing* trap in the strategic decision making context. For example, in the study by Hodgkinson *et al.* (1999), students and senior bank managers presented with tasks posed both in a positively and negatively framed version tend to choose the risk-seeking



situation when facing a negative framed version of the problem. This demonstrates the link between the framing trap and the risk aversion variable.

The dangerousness of this trap is determined by the fact that the different frame of a problem situation can emerge from a number of factors; for example, also looking at other people's results. Indeed, according to Fox and Dayan (2004), people are influenced by their own achievements in stock investments and by those of their peers relative to their own; in practice, others' results work as a frame for identifying the goodness of performance. In particular, people perceive a gain only when others perform equally to them; if others gain more than them, the result is perceived as a loss, even if it is not.

Moreover, variables that affect risk perception may be other biases themselves. Indeed, as proved by Simon *et al.* (2000), individuals aiming at starting new ventures do not perceive the risks involved, mainly through being affected by the law of small numbers and overconfidence in their abilities. Decision makers, in practice, perceive less risk because they use a small sample of information to draw firm conclusions; furthermore, they do not recognize that some important firms' tasks are beyond their control. This evidence is also confirmed by Peon *et al.* (2016), who find that the investment risk behaviour of people is mainly driven by the combined effect of high levels of overconfidence and risk-seeking.

All this stated, another advancement made in prospect theory is the recognition of the left-digit effect as a frame that can influence risk behaviour. Indeed, the analysis by Fraser-Mackenzie *et al.* (2015), about buy-sell imbalances in over 15 million trades by investors in a financial market, demonstrates that decisions regarding losses are more affected by this particular frame than decisions regarding gains – pushing, *de facto*, to a change in risk behaviour. Furthermore, time pressure can also be another framing variable for risky decisions; indeed, for prospects that concern both losses and gains, decision makers are contemporarily loss averse and gain seeking under time pressure, thus depending on the

framing of the prospects (Kocher *et al.*, 2013).

Nonetheless, when the analysis of the framing trap shifts from individuals to groups, there are more chances to overcome it. In particular, as recently shown by Curseu *et al.* (2016), groups of professionals who operate according to collaborative decision rules rarely tend to change their preferences under the gain-loss frames and, as a result, are more aligned with rational axioms. However, if the opinions of the group members do not differ, they can fall into groupthink behaviour, thus the tendency to minimize conflicts, such as to reach a consensus decision, that in turn leads to the self-reinforcing of their points of view.

From this last point, it seems clear that an interaction should exist between the framing trap and the risk of being anchored to the information provided (Wu and Cheng, 2011), which, as a consequence, may increase the overconfidence of the decision maker. In this regard, scholars have deepened the relationship between framing and overconfidence (e.g., Landie *et al.*, 2016), reaching the shared conclusion that the negative framing of a strategic problem has a positive impact on decision making processes, because overconfident decision makers are pushed to more appropriate group processes and analysis; conversely, in the presence of a positive frame, overconfident people tend to reduce their efforts in decision making.

## **7. Discussion**

Our study has been aimed at addressing the classical, but still lively, questions of why and how cognitive distortions in managerial decision making occur. In this regard, we have started from Simon's bounded rationality (1947) and its associated assumptions about the cognitive aspects of the decision makers' mistakes. Over time, scholars have also contributed to bounded rationality with studies of a psychological nature, because "judgement refers to the cognitive aspects of the decision making process" (Bazerman and Moore, 2013, p. 1). In this vein, stemming from the fact that the individual's representation of objects, goals, and

actions, in a problem situation (i.e., the problem space [Newell and Simon, 1972]) has, at its basis, the cognitive representation of the overall problem (Greeno and Simon, 1984), the distortions – heuristics and biases – that may occur in problem solving are certainly related to the cognitive functioning of the involved decision makers.

On the basis of this theoretical premise, we have thus contemporaneously adopted the frameworks developed by Kahneman *et al.* (2011), and Bazerman and Moore (2013), to critically review the representative literature most recently published about cognitive distortions in managerial decision making. As exposed in the review – and further discussed in this section – insights from our analysis can have a two-fold value: on the one hand, they can support the de-biasing activity of practitioners, allowing them to recognize the inner distortions potentially occurring while making management decisions; on the other hand, they can support scholars with more fine-grained lenses when studying cognitive distortions, through exploiting the most vividly intertwined relationships between biases and their emanating heuristics.

This introduced, among the different evidence emerging from the contents of our work, what seems to merit additional attention here, especially for its theoretical and prescriptive implications for the management development, is that the most recent advancements in the management literature are focusing on the interactions among heuristics and on their joint effect on decision making processes. In fact, connections seem to exist among all the four emanating heuristics; some heuristics have a univocal direction, while others reciprocally affect each other. We label this intertwined influencing network of heuristics as the *heuristic co-evolving diamond* (Figure 1).

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Insert Figure 1 about here  
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As Figure 1 shows, considering that, on the basis of the reviewed literature, all the discussed main distortions can be equally conceived as internally generated by the interactions among the four emanating heuristics, a pivotal role in the diamond seems to be played by affect. On the one hand, affect influences the weight of positive and negative outputs within risky decisions; while, on the other hand, its distortional power depends on the framing of options and on the available information at the time of the decision making process (e.g., Schlösser *et al.*, 2013; Townsend *et al.*, 2014). Depending on the positive or negative affective state felt by the decision maker, the affective states resulting from this twofold process may lead to different search strategies and effort in collecting new information (e.g., Welpe *et al.*, 2012; Bachkirov, 2015). On this basis, the decision maker may fall into a self-reinforcing process (e.g., Abatecola, 2014), in which her/his confidence about the choice's information drastically increases or decreases. In particular, the perceived risk of alternatives can lead to the confirmation bias and *vice versa*, such as in the case of the anchoring mechanism coming out from the framing of options (e.g., Workman, 2012) and from the decision makers' optimism, which can push towards a low perception of risk (e.g., Pandher and Currie, 2013). The consequence of decision makers' overconfidence is to rely more on their own cognitive abilities, thus on mental schemas and related shortcuts (e.g., Langabeer and DelliFraine, 2011). As a result, the conscious or unconscious implementation of biases generally brings confirming evidence, which affects the vicious (or virtuous) loop (e.g., Malhotra *et al.*, 2015).

From what we have argued above, the emanating heuristics and their associated biases interact in a way that can reinforce or reduce the overall biasing effect; distortions, in practice, co-evolve (e.g., Breslin, 2011; Abatecola, 2012). In other words, the self-reinforcing dynamic can be recognized not only in the *heuristics-heuristics*, but also in the *heuristics-biases* relationship. In the former, for example, we could consider affect and risk aversion: in this

regard, decision makers usually choose the most touching alternative according to the degree of risk perceived during the decision making process and, *vice versa*, affective states are influenced (e.g., Schlösser *et al.*, 2013; Townsend *et al.*, 2014). In the latter, instead, we could consider confirmation and anchoring: on this side, decision makers who tend to find confirming data are also inclined to anchor their opinions to their own available knowledge base, which, in turn, reinforces their search strategy based on looking at corroborating evidence (e.g., Workman, 2012; Malhotra *et al.*, 2015). In practice, the availability/representativeness heuristic is determined, in some terms, by the confirmation heuristic (and *vice versa*).

### *7.1. Implications and conclusions*

We believe that deepening the study of the co-evolving relationships between heuristics and biases discussed in our work can have important prescriptive implications in terms of management development and de-biasing techniques, because it can help shed light on the overall effect of cognitive distortions in managerial decision making – an effect which, from some aspects, still seems to be under-investigated. For example, although availability and representativeness have been generally recognized as working together in biasing decision makers' judgment, only in recent times has their distortional combination with affect, in assessing risk perception, been acknowledged. Indeed, the assessment of risk in a time-pressure situation is based on the contemporarily or subsequent activation of the decision makers' mind attempting to recall past experience in which a similar event happened, as well as eliciting some feelings that are directly connected to the object of evaluation. Thus, it clearly emerges that heuristics are strategies derived from previous experiences dealing with similar problems and they are prevalently used when the individual experiences have a high cognitive load; heuristics, in practice, work by recalling vivid information from the prior

experience of the decision maker, but, unfortunately, they can affect the subsequent decision making activities, even if they are only partially connected with those activities elicited by memory.

In conclusion, to show how the framework emerging from our review can support the de-biasing activity, an example from the practice of business can be useful: a manager understanding that, because of the empathy they share, she/he has fallen in the affect emanating heuristic when favorably assessing a subordinate's job, should question herself/himself about the subsequent potential cognitive distortions she/he has fallen into because of the former; cognitive distortions such as that of being superficial in evaluating and, potentially, even promoting the subordinate. Thus, being aware of this intertwined relationship among emanating heuristics and biases can help decision makers in controlling their decision making processes: such as, for example, asking an equivalent manager or the HR specialist to make a personal evaluation of the subordinate, in order to reframe her/his real value in the job.

“Firms are contrived systems. They are made of men and are imperfect systems” (Katz and Khan, 1966, p. 33). If we take into account this seminal, but everlasting, assumption on how businesses are run (Cafferata, 2016), understanding why and how cognitive distortions can happen in managerial decision making (and how they can be de-biased) continues to merit pivotal attention to support future management development.

## References

- Abatecola, G. (2012), "Interpreting corporate crises: towards a co-evolutionary approach", *Futures*, Vol. 44 No. 10, pp. 860-869.
- Abatecola, G. (2014), "Untangling self-reinforcing processes in managerial decision making. Co-evolving heuristics?", *Management Decision*, Vol. 52 No. 5, pp. 934-949.
- Abatecola, G. and Uli, V. (2016), "Entrepreneurial competences, liability of newness and infant survival: evidence from the service industry", *Journal of Management Development*, Vol. 35 No. 9, pp. 1082-1097.
- Adizes, I. (2004), *Leading the Leaders*, The Adizes Institute, Carpinteria.
- Artinger, F., Petersen, M., Gigerenzer, G. and Weibler, J. (2015), "Heuristics as adaptive decision strategies in management", *Journal of Organizational Behavior*, Vol. 36 No. S1, pp. S33-S52.
- Azas, O.H. (2014), "The default heuristic in strategic decision making: when is it optimal to choose the default without investing in information search?", *Journal of Business Research*, Vol. 67 No. 8, pp. 1744-1748.
- Bachkirov, A. (2015), "Managerial decision making under specific emotions", *Journal of Managerial Psychology*, Vol. 30 No. 7, pp. 861-874.
- Bazerman, M.H. and Moore, D. (2013), *Judgment in Managerial Decision Making* (5<sup>th</sup> ed.), Wiley, New York.
- Bingham, C.B. and Eisenhardt, K.M. (2011), "Rational heuristics: the *simple rules* that strategists learn from process experience", *Strategic Management Journal*, Vol. 32 No. 13, pp. 1437-1464.
- Blay, A.D., Kadous, K. and Sawers, K., (2012), "The impact of risk and affect on information search efficiency", *Organizational Behavior and Human Decision Processes*, Vol. 117 No. 1, pp. 80-87.
- Breslin, D. (2011), "Interpreting futures through the multi-level co-evolution of organizational practices", *Futures*, Vol. 43 No. 9, pp. 1020-1028.
- Cafferata, R. (2016), "Darwinist connections between the systemness of social organizations and their evolution", *Journal of Management and Governance*, Vol. 20 No. 1, pp. 19-44.
- Cain, D.A., Moore, D.A. and Haran, U. (2015), "Making sense of overconfidence in market entry", *Strategic Management Journal*, Vol. 36 No. 1, pp. 1-18.
- Caputo, A. (2013), "A literature of cognitive biases in negotiation processes", *International Journal of Conflict Management*, Vol. 24 No. 4, pp. 374-398.
- Caputo, A. (2014), "Relevant information, personality traits and anchoring effect", *International Journal of Management and Decision Making*, Vol. 13 No. 1, pp. 62-76.
- Caputo, A. (2016), "Overcoming judgmental biases in negotiations: a scenario-based survey analysis on third party direct intervention", *Journal of Business Research*, Vol. 69 No. 10, pp. 4304-4312.
- Chen, G., Crossland, C. and Luo, S. (2015), "Making the same mistake all over again: CEO overconfidence and corporate resistance to corrective feedback", *Strategic Management Journal*, Vol. 36 No. 10, pp. 1513-1535.
- Clark, B.B., Robert, C. and Hampton, S.A. (2016), "The technology effect: how perceptions of technology drive excessive optimism", *Journal of Business and Psychology*, Vol. 31 No. 1, pp. 87-102.
- Coget, J.F., Haag, C. and Gibson, D.E. (2011), "Anger and fear in decision-making: the case of film directors on set", *European Management Journal*, Vol. 29 No. 6, pp. 476-490.
- Cristofaro, M. (2017a), "Herbert Simon's bounded rationality: its historical evolution in management and cross-fertilizing contribution", *Journal of Management History*, Vol. 23 No. 2, pp. 170-190.

- Cristofaro, M. (2017b), "Candidates' attractiveness in selection decisions: a laboratory experiment", *Baltic Journal of Management*, Vol. 12 No. 4, pp. 390-407.
- Cristofaro, M. (2017c), "Reducing biases of decision making processes in complex organizations", *Management Research Review*, Vol. 40 No. 3, pp. 270-291.
- Curseu, P.L., Schruijer, S.G.L and Fodor, O.C. (2016), "Decision rules, escalation of commitment and sensitivity to framing in group decision-making", *Management Decision*, Vol. 54 No. 7, pp. 1649-1668.
- Davis, B.C., Hmieleski, K.M., Webb, J.W. and Coombs, J.E. (2017), "Funders' positive affective reactions to entrepreneurs' crowdfunding pitches: The influence of perceived product creativity and entrepreneurial passion", *Journal of Business Venturing*, Vol. 32 No. 1, pp. 90-106.
- Dreman, D. (2004), "The influence of affect on investor decision-making", *Journal of Behavioral Finance*, Vol. 5 No. 2, pp. 70-74.
- Elsbach, K.D. and Barr, P.S. (1999), "The effects of mood on individuals' use of structured decision protocols", *Organization Science*, Vol. 10 No. 2, pp. 81-108.
- Finucane, M.L., Alhakami, A., Slovic, P. and Johnson, S.M. (2000), "The affect heuristic in judgments of risks and benefits", *Journal of Behavioral Decision Making*, Vol. 13 No. 1, pp. 1-17.
- Fox, S. and Dayan, K. (2004), "Framing and risky choice as influenced by comparison of one's achievements with others: the case of investment in the stock exchange", *Journal of Business and Psychology*, Vol. 18 No. 3, pp. 301-321.
- Fraser-Mackenzie, P., Sung, M. and Johnson, J.E.V. (2015), "The prospect of a perfect ending: loss aversion and the round-number bias", *Organizational Behavior and Human Decision Processes*, Vol. 131, pp. 67-80.
- Gigerenzer, G., and Selten, R. (Eds., 2002), *Bounded Rationality: The Adaptive Toolbox*, The MIT Press, Cambridge & London.
- Graf, L., König, A., Enders, A. and Hungenberg, H. (2012), "Debiasing competitive irrationality: how managers can be prevented from trading off absolute for relative profit", *European Management Journal*, Vol. 30 No. 4, pp. 386-403.
- Graffin, S.D., Boivie, S. and Carpenter, M.A. (2013), "Examining CEO succession and the role of heuristics in early-stage CEO evaluation", *Strategic Management Journal*, Vol. 34 No. 4, pp. 383-403.
- Greeno, J.G. and Simon, H.A. (1984), *Problem Solving and Reasoning*, Technical Report, Defense Technical Information Center, Fort Belvoir, VA.
- Gudmundsson, S.V. and Lechner, C. (2013), "Cognitive biases, organization, and entrepreneurial firm survival", *European Management Journal*, Vol. 31 No. 3, pp. 278-294.
- Hammond, S.H., Keeney, R.L. and Raiffa, H. (1998), "The hidden traps in decision making", *Harvard Business Review*, Vol. 76 No. 5, pp. 47-58.
- Hilbert, M. (2012), "Toward a synthesis of cognitive biases: how noisy information processing can bias human decision making", *Psychological Bulletin*, Vol. 138 No. 2, pp. 211-237.
- Hodgkinson, G.P., Bown, N.J., Maule, A.J., Glaister, K.W. and Pearman, A.D. (1999), "Breaking the frame: an analysis of strategic cognition and decision making under uncertainty", *Strategic Management Journal*, Vol. 20 No. 10, pp. 977-985.
- Jones, J. (2015), "Information graphics and intuition: heuristics as a techne for visualization", *Journal of Business and Technical Communication*, Vol. 29 No. 3, pp. 284-313.
- Kahneman, D. (2003), "A perspective on judgment and choice: mapping bounded rationality", *American Psychologist*, Vol. 58 No. 9, pp. 697-720.
- Kahneman, D. (2011), *Thinking, Fast and Slow*, Macmillan, New York.



- Kahneman, D., Lovallo, D. and Sibony, O. (2011), "The big idea. Before you make that big decision", *Harvard Business Review*, Vol. 89 No. 6, pp. 50-60.
- Kahneman, D. and Tversky, A. (1974), "Subjective probability: a judgment of representativeness", in Axen, C. and Von Holstein, S.S. (Eds.), *The Concept of Probability in Psychological Experiments*, Springer, The Netherlands, (pp. 25-48).
- Kahneman, D. and Tversky, A. (1979), "Prospect theory: an analysis of decisions under risk", *Econometrica*, Vol. 47 No. 2, pp. 263-291.
- Katz, D. and Kahn, R.L. (1966), *The Social Psychology of Organizations*, Wiley, New York.
- Klein, G. (2007), "Performing a project *premortem*", *Harvard Business Review*, Vol. 85 No. 9, pp. 18-19.
- Kocher, M.G., Pahlke, J. and Trautmann, S.T. (2013), "Tempus fugit: time pressure in risky decisions", *Management Science*, Vol. 59 No. 10, pp. 2380-2391.
- Landie, Q., Cranage, D. and Mattila, A.S. (2016), "How anchoring and self-confidence level influence perceived saving on tensile price claim framing", *Journal of Revenue & Pricing Management*, Vol. 15 No. 2, pp. 138-152.
- Langabeer, J.R. and DelliFraine, J. (2011), "Does CEO optimism affect strategic process?", *Management Research Review*, Vol. 34 No. 8, pp. 857-868.
- Liu, C., Vlaev, I., Fang, C., Denrell, J. and Chater, N. (2017), "Strategizing with biases: making better decisions using the Mindspace approach", *California Management Review*, Vol. 59 No. 3, pp. 135-161.
- Malhotra, S., Zhu, P. and Reus, T.H. (2015), "Anchoring on the acquisition premium decisions of others", *Strategic Management Journal*, Vol. 36 No. 12, pp. 1866-1876.
- Mazutis, D. and Eckardt, A. (2017), "Sleepwalking into catastrophe: cognitive biases and corporate climate change inertia", *California Management Review*, Vol. 59 No. 3, pp. 74-108.
- Meissner, P. and Wulf, T. (2017), "The effect of cognitive diversity on the illusion of control bias in strategic decisions: An experimental investigation", *European Management Journal*, Vol. 35 No. 4, pp. 430-439.
- Meyer, W.G. (2014), "The effect of optimism bias on the decision to terminate failing projects", *Project Management Journal*, Vol. 45 No. 4, pp. 7-20.
- Mitchell, J.R. and Shepherd, D.A. (2011), "Erratic strategic decisions: when and why managers are inconsistent in strategic decision making", *Strategic Management Journal*, Vol. 32 No. 7, pp. 683-704.
- Mugerman, Y., Moran, O. and Wiener, Z. (2016), "How do homeowners choose between fixed and adjustable rate mortgages?", *Quarterly Journal of Finance*, Vol. 6 No. 4, pp. 1-27.
- Newell, A. and Simon, H.A. (1972), *Human Problem Solving*, Prentice Hall, Englewood Cliffs.
- Pachur, T. and Galesic, M. (2013), "Strategy selection in risky choice: the impact of numeracy, affect, and cross-cultural differences", *Journal of Behavioral Decision Making*, Vol. 26 No. 3, pp. 260-271.
- Pachur, T., Hertwig, R. and Steinmann, F. (2012), "How do people judge risks: availability heuristic, affect heuristic, or both?", *Journal of Experimental Psychology: Applied*, Vol. 18 No. 3, pp. 314-330.
- Pandher, G. and Currie, R. (2013), "CEO compensation: a resource advantage and stakeholder-bargaining perspective", *Strategic Management Journal*, Vol. 34 No. 1, pp. 22-41.
- Park, S.H., Westphal, J.D. and Stern, I. (2011), "Set up for a fall: the insidious effects of flattery and opinion conformity towards corporate leaders", *Administrative Science Quarterly*, Vol. 56 No. 2, pp. 257-302.

- Pentland, A.S. (2013), "Beyond the echo chamber", *Harvard Business Review*, Vol. 91 No. 11, pp. 80-86.
- Peon, D., Antelo, M. and Calvo, A. (2016), "Overconfidence and risk seeking in credit markets: an experimental game", *Review of Managerial Science*, Vol. 10 No. 3, pp. 551-552.
- Powell, T.C. (2017), "Strategy as diligence: putting behavioural strategy into practice", *California Management Review*, Vol. 59 No. 3, pp. 162-190.
- Schlösser, T., Dunning, D. and Fetchenhauer, D. (2013), "What a feeling: the role of immediate and anticipated emotions in risky decisions", *Journal of Behavioral Decision Making*, Vol. 26 No. 1, pp. 13-30.
- Sharot, T. (2011), "The optimism bias", *Current Biology*, Vol. 21 No. 23, R941-R945.
- Shiller, R.J. (2005), *Irrational Exuberance* (2<sup>nd</sup> ed.), Princeton University Press, Princeton.
- Sibony, O., Lovallo, D. and Powell, T.C. (2017), "Behavioral strategy and the strategic decision architecture of the firm", *California Management Review*, Vol. 59 No. 3, pp. 5-21.
- Simon, H.A. (1947), *Administrative Behavior*, The Free Press, New York.
- Simon, M., Houghton, S.M. and Aquino, K. (2000), "Cognitive biases, risk perception, and venture formation: how individuals decide to start companies", *Journal of Business Venturing*, Vol. 15 No. 2, pp. 113-134.
- Sokolowska, J. and Sleboda, P. (2015), "The inverse relation between risks and benefits: the role of affect and expertise", *Risk Analysis*, Vol. 35 No. 7, pp. 1252-1267.
- Townsend, E., Spence, A. and Knowles, S. (2014), "Investigating the operation of the affect heuristic: is it an associative construct?", *Journal of Risk Research*, Vol. 17 No. 3, pp. 299-315.
- Tversky, A. and Kahneman, D. (1973), "Availability: a heuristic for judging frequency and probability", *Cognitive Psychology*, Vol. 5 No. 2, pp. 207-232.
- Tversky, A. and Kahneman, D. (1974), "Judgment under uncertainty: heuristics and biases", *Science*, No. 185, pp. 1124-1131.
- Tversky, A. and Kahneman, D. (1981), "The framing of decisions and the psychology of choice", *Science*, Vol. 211 No. 4481, pp. 453-458.
- Wählberg, A.A. and Sjöberg, L. (2000), "Risk perception and the media", *Journal of Risk Research*, Vol. 3 No. 1, pp. 31-50.
- Welp, I.M., Sporrle, M., Grichnik, D., Michl, T. and Audretsch, D.B. (2012), "Emotions and opportunities: the interplay of opportunity evaluation, fear, joy, and anger as antecedent of entrepreneurial explanation", *Entrepreneurship Theory & Practice*, Vol. 36 No. 1, pp. 69-96.
- Workman, M. (2012), "Bias in strategic initiative continuance decisions: framing interactions and HRD practices", *Management Decision*, Vol. 50 No. 1, pp. 21-42.
- Wu, C.-S. and Cheng, F.-F. (2011), "The joint effect of framing and anchoring on internet buyers' decision-making", *Electronic Commerce Research and Applications*, Vol. 10 No. 3, pp. 358-368.
- Yahaya, R. and Ebrahim, F. (2016), "Leadership styles and organizational commitment: a literature review", *Journal of Management Development*, Vol. 35 No. 2, pp. 190-216.
- Zajonc, R.B. (1980), "Feeling and thinking. Preferences need no inferences", *American Psychologist*, Vol. 35 No. 2, pp. 151-175.

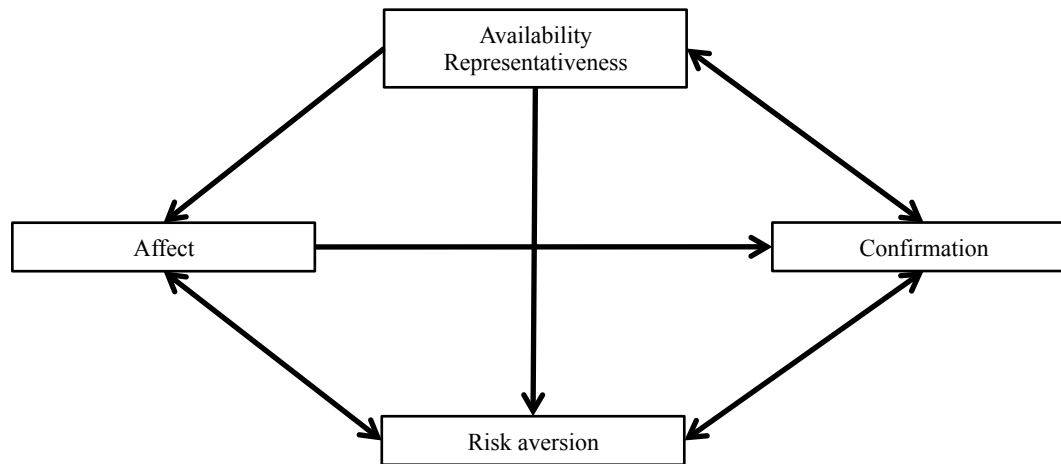
**Table 1.** The review framework: From cognitive traps to emanating heuristics

Questions	Associated Trap(s)	Emanating Heuristic(s)	Recent Representative Evidence (*)
1) Is there any reason to suspect the team making the recommendation of errors motivated by self-interest?	Self-serving	Affect	Coget <i>et al.</i> (2011); Blay <i>et al.</i> (2012); Welpé <i>et al.</i> (2012); Pachur and Galesic (2013); Schlösser <i>et al.</i> (2013); Townsend <i>et al.</i> (2014); Bachkirov (2015); Sokolowska and Sledoba (2015); Davis <i>et al.</i> (2017)
2) Has the team fallen in love with its proposal?	Emotion and cognition collision		
3) Were there dissenting opinions within the team? Were they explored adequately?	Emotion and cognition collision		
4) Could the diagnosis be overly influenced by an analogy to a memorable success?	Ease of recall/Retrievability	Availability/ Representativeness	Bingham and Eisenhardt (2011); Mitchell and Shepherd (2011); Pachur <i>et al.</i> (2012); Graffin <i>et al.</i> (2013); Pentland (2013); Bachkirov (2015); Jones (2015); Mugerman <i>et al.</i> (2016)
5) Are credible alternatives included along with the recommendation?	Ease of recall/Retrievability		
6) If you had to make this decision again in a year's time, what information would you want? And can you get more of it now?	Ease of recall/Retrievability		
7) Do you know where the numbers came from?	Anchoring	Confirmation	Langabeer and DelliFraine (2011); Park <i>et al.</i> (2011); Sharot (2011); Workman (2012); Gudmundsson and Lechner (2013); Pandher and Currie (2013); Caputo (2014); Meyer (2014); Cain <i>et al.</i> (2015); Chen <i>et al.</i> (2015); Malhotra <i>et al.</i> (2015); Clark <i>et al.</i> (2016)
8) Is the team assuming that a person, organization, or approach that is successful in one area will be as successful in another?	Hindsight and the curse of knowledge		
9) Are the recommenders overly attached to a history of past decisions?	Hindsight and the curse of knowledge		
10) Is the best case overly optimistic?	Overconfidence/Optimism		
11) Is the worst case bad enough?	Overconfidence/Optimism		
12) Is the recommending team overly cautious?	Framing	Risk Aversion	Wu and Cheng (2011); Blay <i>et al.</i> (2012); Kocher <i>et al.</i> (2013); Fraser-Mackenzie <i>et al.</i> (2015); Curseu <i>et al.</i> (2016); Landie <i>et al.</i> (2016); Peon <i>et al.</i> (2016)

Source: elaboration on Kahneman *et al.* (2011) and Bazerman and Moore (2013).

\*: in increasing chronological order.

**Figure 1.** The heuristic co-evolving diamond



**Note:** → = 1-way effect; ↔ = 2-way effect.